

WHAT IS CLAIMED IS:

1. A stereo calibration apparatus for obtaining a transformation matrix, which is an image transformation  
5 parameter between a pair of image pickup devices for photographing a preset common area, the stereo calibration apparatus comprising:

an image input device to which a pair of images is input from the one pair of image pickup devices;

10 a straight-line detector detecting at least four straight lines from each of images output from the image input device;

a straight-line correspondence detector detecting at least four sets of corresponding lines between the images by using an image feature in neighboring areas of the straight  
15 lines; and

a transformation matrix calculator calculating the transformation matrix by using the sets of corresponding lines.

2. The stereo calibration apparatus according to claim  
20 1, wherein the straight-line correspondence detector performs area matching by using the image feature in the neighboring areas of the straight lines to detect the sets of corresponding lines.

25 3. The stereo calibration apparatus according to claim

1, wherein:

the straight-line correspondence detector obtains data series regarding the image feature from the neighboring area of each straight line,

5 obtains a normalized distance between the data series for each straight line detected from one of the images and the data series for each straight line detected from the other of the images, and

10 obtains the sets of corresponding straight lines sets in such a manner that one straight line in the other of the images, which has the minimum normalized distance with respect to one straight line in the one of the images, is set as a corresponding line to the one straight line in the one of the images.

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4. The stereo calibration apparatus according to claim 1, wherein the transformation matrix calculator calculates the transformation matrix in accordance with a linear expression by using the sets of corresponding lines and a projective  
20 transformation expression regarding the straight lines.

5. A stereo calibration method for obtaining a transformation matrix, which is an image transformation parameter between a pair of image pickup devices for  
25 photographing a preset common area, the method comprising:

inputting a pair of images from the image pickup devices;  
detecting at least four straight lines from each of input  
images;

detecting at least four sets of corresponding lines  
5 between the images by using an image feature in neighboring  
areas of the straight lines; and

calculating the transformation matrix between the image  
pickup devices by using the sets of corresponding lines.

10 6. A program which is executed by a computer to perform  
a process for obtaining a transformation matrix, which is an  
image transformation parameter between a pair of image pickup  
devices for photographing a preset common area, the process  
comprising:

15 inputting a pair of images from the image pickup devices;  
detecting at least four straight lines from each of input  
images;

detecting at least four sets of corresponding lines  
between the images by using an image feature in neighboring  
20 areas of the straight lines; and

calculating the transformation matrix between the image  
pickup devices by using the sets of corresponding lines.

7. A stereo image monitor for detecting an object,  
25 the stereo image monitor comprising:

a pair of image pickup devices configured to photograph images containing a common area;

a straight-line detector detecting at least four straight lines from each of the images;

5 a straight-line correspondence detector detecting at least four sets of corresponding lines between the images by using an image feature in neighboring areas of the straight lines;

a transformation matrix calculator calculating the  
10 transformation matrix by using the sets of corresponding lines;  
and

a monitor transforming one of the pair of images by using the transformation matrix to detect an object in the common area.

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8. A stereo image monitoring method for monitoring a common area, which photographed by a pair of image pickup devices, the method comprising:

inputting a pair of images from the image pickup devices;

20 detecting at least four straight lines from each of input images;

detecting at least four sets of corresponding lines between the images using an image feature in neighboring areas of the straight lines;

25 calculating a transformation matrix between the image

pickup devices by using the sets of corresponding lines; and  
transforming one of the pair of images by using the  
transformation matrix to detect an object in the common area.

5           9.     A program which is executed by a computer to perform  
a process for monitoring a common area, which photographed by  
a pair of image pickup devices, the process comprising:

          inputting a pair of images from the image pickup devices;  
          detecting at least four straight lines from each of input  
10 images;

          detecting at least four sets of corresponding lines  
between the images by using an image feature in neighboring  
areas of the straight lines;

          calculating a transformation matrix between the image  
15 pickup devices by using the sets of corresponding lines; and  
          transforming one of the pair of images by using the  
transformation matrix to detect an object in the common area

          10.    A stereo calibration apparatus for obtaining a  
20 transformation matrix, which is an image transformation  
parameter between a pair of image pickup devices for  
photographing a preset common area, the stereo calibration  
apparatus comprising:

          an image input device to which a pair of images is input  
25 from the one pair of image pickup devices;

a straight-line detector detecting at least four straight lines from each of images output from the image input device;

a straight-line correspondence detector detecting at least four sets of corresponding lines between the images by  
5 using a geometrical relation among the straight lines; and

a transformation matrix calculator calculating the transformation matrix by using the sets of corresponding lines.

11. The stereo calibration apparatus according to claim  
10 10, wherein the straight-line correspondence detector obtains the geometrical relation among the straight lines by using an intersection between one of the straight lines in each image and the others of the straight lines in each image.

15 12. The stereo calibration apparatus according to claim 10, wherein the straight-line correspondence detector uses an image feature in neighboring areas of the straight lines and the geometrical relation to obtain the sets of corresponding lines.

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13. A stereo calibration method for obtaining a transformation matrix, which is an image transformation parameter between a pair of image pickup devices for photographing a preset common area, the method comprising:

25 inputting a pair of images from the image pickup devices;

detecting at least four straight lines from each of input  
images;

detecting at least four sets of corresponding lines  
between the images by using a geometrical relation among the  
5 straight lines; and

calculating the transformation matrix between the image  
pickup devices by using the sets of corresponding lines.

14. A program causing a computer to perform a process  
10 for obtaining a transformation matrix, which is an image  
transformation parameter between a pair of image pickup devices  
for photographing a preset common area, the process comprising:

inputting a pair of images from the image pickup devices;  
detecting at least four straight lines from each of input  
15 images;

detecting at least four sets of corresponding lines  
between the images by using a geometrical relation among the  
straight lines; and

calculating the transformation matrix between the image  
20 pickup devices on by using the sets of corresponding lines.

15. A stereo image monitor for detecting an object,  
the stereo image monitor comprising:

a pair of image pickup devices configured to photograph  
25 images containing a common area;

an image input device to which a pair of images is input  
from the image pickup devices;

a straight-line detector detecting at least four straight  
lines from each of images output from the image input device;

5 a straight-line correspondence detector detecting at  
least four sets of corresponding lines between the images by  
using a geometrical relation among the straight lines;

a transformation matrix calculator calculating the  
transformation matrix by using the sets of corresponding lines;

10 and

a monitor performing transforming one of the pair of images  
by using the transformation matrix to detect an object in the  
common area.

15 16. A stereo image monitoring method for monitoring  
a common area, which photographed by a pair of image pickup  
devices, the method comprising:

inputting a pair of images from the image pickup devices;

20 detecting at least four straight lines from each of input  
images;

obtaining at least four sets of corresponding lines  
between the images by using a geometrical relation among the  
straight lines;

25 calculating a transformation matrix between the image  
pickup devices by using the sets of corresponding lines; and



transforming one of the pair of images by using the transformation matrix to detect an object in the common area.

17. A program which is executed by a computer to perform
- 5 a process for monitoring a common area, which photographed by a pair of image pickup devices, the process comprising:
- inputting a pair of images from the image pickup devices;
  - detecting at least four straight lines from each of input images;
  - 10 detecting at least four sets of corresponding lines between the images by using a geometrical relation among the straight lines;
  - calculating a transformation matrix between the image pickup devices by using the sets of corresponding lines; and
  - 15 transforming one of the pair of images by using the transformation matrix to detect an object in the common area on the basis of a stereoscopic principle.